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## Hurdles in implementing sustainable supply chain management: An analysis of Indian automobile sector

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### Abstract

Sustainability has been becoming an imperative research agenda among the researchers/practitioners to achieve ecological, societal as well as financial benefits. As the moment, Sustainable Supply Chain Management (SSCM) practices are at very initial phase in developing countries like India due to existence of many hurdles. In present research, an effort has been made to identify and evaluate hurdles in implementing SSCM in Indian automobile sector. Literature review approach and experts' inputs have been used to identify hurdles in implementing SSCM. Interpretive Structural Modeling (ISM) methodology has been utilized to understand the contextual relationships among these identified hurdles, their interdependence and hierarchy levels to implement SSCM practices in Indian automobile sector. MICMAC analysis has also been used to categorize identified hurdles according to their importance. 'Political Instability' has been reported as most driver hurdle in implementing SSCM. 'Unawareness among society about social practices' has been found as most dependent hurdle of the present study. We believe that, this paper will surely help business practitioners/researchers/scholars in broadening research in this emerging area and developing new theories/proposition. This paper may provide important future research directions towards increasing effectiveness of sustainability in the supply chains.

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**Keywords:** Supply chain management; genetic algorithm; stockout and backordering; production and distribution planning; plant side restriction.

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## Introduction

In last few years, climate change and its impacts on the society are gaining momentum; and managing sustainable issues in supply chain are becoming very important in today's business scenario to achieve the environmental, social and economic performances (Costello et al., 2009; Morali and Searcy, 2013; Mangla et al., 2014a, 2014b).

Therefore, business managers/practitioners are under intense pressure to lessen the harmful ecological and social impacts at the same maintaining economies in their supply chains (Ağan et al., 2014; Mangla et al., 2014c). Sustainable Supply Chain Management (SSCM) has been identified as an appropriate solution to balance environmental, social as well as economic benefits in supply chain (Luthra et al., 2014a, 2014b).

Although, the literatures on theory and practice of SSCM have been increasing rapidly but still many firms are exploring for the best ways to incorporate sustainability principles into their supply chain. SSCM practices are in very initial to recognize hurdles in the Original Equipment Manufacturing (OEM) firms as well as the supplier firms to OEM towards effective implementation of SSCM to achieve associated benefits (Ageron et al., 2012). Therefore, it has been observed important to identify and analyze various hurdles in implementing SSCM by taking a case of Indian automobile sector. This research has the following objectives, as follows:

- Identification of various hurdles in implementing SSCM from Indian automobile sector viewpoints;
- Finding contextual relationships among identified hurdles and their hierarchical levels in implementing SSCM
- Development of a hierarchical structural model of these hurdles in implementing SSCM.

Literature review methodology has been acknowledged as a suitable and valid approach (Luthra et al., 2014c) for identifying hurdles in implementing SSCM. ISM has been identified as an appropriate tool to identify the contextual relationships among elements and to develop hierarchical structural model of these hurdles. MICMAC analysis has been used to validate the developed ISM based hierarchy structural model.

### 1.1. Structure

Hurdles in implementing SSCM have been identified through reviewing the relevant literature in Section 2. Methodology used in the present research has been explained in section 3. The results and discussions of the presented research have been presented in Section 4. In the last section, Conclusions have been drawn with limitations and directions for future research.

## 2. Identification of hurdles in implementing SSCM

We have explored various available literatures: national and international journals and proceedings of national and international conferences; and research organizations. Important Ten hurdles in implementing SSCM have been identified from extensive literature review and explained as follows:

### 2.1. Lack of legislative framework

Legislative framework may be an important for creating a favorable environment for businesses to adopt SCCM by providing policy frameworks and can ultimately create demand for sustainable products (Luthra et al., 2010; Gouldson and Murphy, 2013). Many researchers reported that there is lack of legislative frameworks and policies, which supports green/sustainable efforts in SCM (Mathiyazhagan et al., 2013; Muduli et al., 2013a; Govindan et al., 2014).

### 2.2. Political instability

Regulatory framework and its related policies to implement green/sustainable issues in any country depend upon the politics of that country. Normally, Regulatory bodies not succeed to expand appropriate support to sustain a green environment issues due to political instability (Govindan et al., 2014). Political instability, corruption and lack

of civil society are major hurdles in implementing green/sustainable regulations and policies (Kumar et al., 2014a; Luthra et al., 2015).

### *2.3 Unawareness among society about social practices*

NGOs and environmental advocacy groups force companies to seriously think about their environmental management programs (Walker et al., 2008). There is a lack of strong environmental conservation or citizen groups in India (Muduli et al., 2013a). Low demand from customers for eco-friendly products due to lack of awareness among society (Mudgal et al., 2010; Govindan et al., 2014; Luthra et al., 2014d).

### *2.4 Lack of customers support*

Lack of customer demand and support become most essential type of external hurdle in implementing GSCM (Luthra et al., 2011; Kumar et al., 2014b). Lack of customer support has been found as one of major hurdles in implementing SSCM practices (Winter and Knemeyer, 2013; Zhu and Geng, 2013).

### *2.5 Top management commitment inadequacy*

Sustainability is a strategic issue, which cannot be possible without the support and commitment of top management (Cetinkaya, 2013). Top management commitment inadequacy of an organization often lacks the internal mechanisms to properly value the benefits of managing environmental sustainability (Govindan et al., 2014).

### *2.6 Financial checks*

Implementation of GSCM/SSCM requires huge amounts of funds and payback periods are very high (Luthra et al., 2011; Luthra et al., 2013; Govindan et al., 2014). Many firms struggle to engage in SSCM because of inadequacy of financial resources because SSCM. SSCM practices implementation programs like supplier/vendor development, changes in existing infrastructure, machinery and equipments, hiring trained personnel etc. are quite expensive and time consuming (Grimm et al., 2014).

### *2.7 Lack of knowledge among SC members*

Lack of knowledge of SC members' sustainability encourages firms to retain the status quo; such inaction is an important hurdle to engaging the SSCM, not to mention increasing the level of sustainability (Vijfinkel et al., 2012; Al Zaabi et al., 2013).

### *2.8 Lack of trust among SC members*

The issue of trust among SC members plays a significant role, since lack of trust is a hurdle for collaboration (Walker et al., 2008; Beske and Seuring, 2014). Trust among SC members to implement SSCM will provide benefits to SC members towards effective implementation of SSCM practices (Ageron et al., 2012).

### *2.9 Technical obstructions*

Technical obstructions have been reported as a key hurdle in Indian industries especially in auto component manufacturing firms (Mathiyazhagan et al., 2013). Technical complexity and non-availability of suitable machinery/equipments within organizations have found major hurdles to adopt green/sustainable supply chain management (Govindan et al., 2014).

### 2.10 Organizational culture resistance to change

Firms fail to implement green/sustainable initiatives due to cultural resistance to change e.g. improper and ineffective communication among SC members, institutional rules and internal politics etc. (Carter and Rogers, 2008). Organization culture resistance may be attributed to person nature for the reason that a few alterations in prior methodologies or in functioning methods demand a fresh manner of thoughts (Muduli et al., 2013b).

### 3. Methodology: Interpretive Structural Modelling (ISM)

ISM was initially suggested by Prof. J. Warfield in order to examine the multifaceted socioeconomic systems and can be used as a systematic tool to identify contextual interactions among considered elements associated with the problem/issue to be analyzed (Warfield, 1974; Sage, 1977). ISM can be summarized in the following steps (Luthra et al., 2011; Haleem et al., 2012; Kumar et al., 2013; Ansari et al., 2013; Mangla et al., 2012, 2013):


- In first step, elements under study need to be listed. In our study, hurdles in implementing SSCM have been recognized as elements.
- In next step, the elements have been operated to form a Structural Self-Interaction Matrix (SSIM). It provided contextual interactions among the elements of the system.
- The SSIM has been operated to develop an initial reachability matrix. Then, it has been checked for transitive relationships to develop final reachability matrix. The transitive relationships means that if a element X is linked to element Y and element Y is linked to element Z, then element X is necessarily linked to element Z.
- In next step, partitioning the reachability matrix into distinct hierarchical levels has been made.
- Further, the digraph by using the contextual interactions recognized in the reachability matrix has been drawn, and further transitive relations have been removed by replacing the element nodes with statements to covert the directed digraph into an ISM model.

### 4. Results and discussions

We formulated a decision team of different experts (three academicians and four Indian automobile industry SC professionals). A brainstorming session among decision team was conducted to inquire about their judgment on significance of hurdles in implementing SSCM in Indian automobile sector. Decision team was asked to rate all identified hurdles on five point Likert scale. Based on mean scores, all identified hurdles were validated by taking Indian automobile sector perspective. Further, brainstorming session among decision team was made to recognize contextual relationships among these identified hurdles to develop *Structural Self Interaction Matrix* (SSIM). Following symbols have been utilized to denote the direction of interaction between two hurdles (say, i and j).

**V**- Hurdle i affect to hurdle j; **A**- Hurdle j affect hurdle i; **X**- Hurdles i and j affect to reach each other and **O**- Hurdles i and j are unconnected. Based on the contextual relationships the SSIM has been developed (Table 1).

Table 1. SSIM for hurdles in implementing SSCM practices.

S. N.	Hurdles in implementing SSCM	Hurdles' Number 								
		10	9	8	7	6	5	4	3	2
1	Lack of legislative framework	V	V	V	V	V	V	V	V	A
2	Political instability	V	V	V	V	V	V	V	V	
3	Unawareness among society about social practices	A	A	A	A	A	A	A		
4	Lack of customer support	A	O	A	A	O	A			
5	Top management commitment inadequacy	V	V	V	V	V				
6	Financial checks	A	O	A	A					
7	Lack of knowledge among SC members	V	V	X						
8	Lack of trust among SC members	X	V							
9	Technical obstructions	A								

## 10 Organizational culture resistance to change

In this step, SSIM is transformed into an Initial Reachability Matrix by replacing symbols with binary numbers. It is a binary matrix, and contains 0 and 1, and follows certain rules, given as:

For every V (i.e. at any (i, j)) in the SSIM, the reachability matrix have 1 for (i, j) and 0 for (j, i); for every A (i.e. at any (i, j)) in the SSIM, the reachability matrix have 0 for (i, j) and 1 for (j, i); For every X (i.e. at any (i, j)) in the SSIM, the reachability matrix have 1 for (i, j) and 1 for (j, i); and For every O (i.e. at any (i, j)) in the SSIM, the reachability matrix have 0 for (i, j) and 0 for (j, i).

Following these rules, we obtain the initial reachability matrix. Next, we constructed the final reachability matrix from initial reachability matrix. The final reachability matrix for hurdles in implementing SSCM was obtained by checking for transitive relationships as explained in ISM methodology and shown in Table 2.

Table 2. Final reachability matrix for hurdles in implementing SSCM practices.

S. N.	Hurdles in implementing SSCM	Hurdles' Number										Driving Power
		1	2	3	4	5	6	7	8	9	10	
1	Lack of legislative framework	1	0	1	1	1	1	1	1	1	1	09
2	Political instability	1	1	1	1	1	1	1	1	1	1	10
3	Unawareness among society about social practices	0	0	1	0	0	0	0	0	0	0	01
4	Lack of customer support	0	0	1	1	0	0	0	0	0	0	02
5	Top management commitment inadequacy	0	0	1	1	1	1	1	1	1	1	08
6	Financial checks	0	0	1	0	0	1	0	0	0	0	02
7	Lack of knowledge among SC members	0	0	1	1	0	1	1	1	1	1	07
8	Lack of trust among SC members	0	0	1	1	0	1	1	1	1	1	07
9	Technical obstructions	0	0	1	0	0	0	0	0	1	0	02
10	Organizational culture resistance to change	0	0	1	1	0	1	1*	1	1	1	07
<b>Dependence Power</b>		02	01	10	07	03	07	06	06	07	06	<b>55/55</b>

\*means value after applying transitivity

The reachability set, the antecedent set and the intersection set were derived for all hurdles in implementing SSCM practices. Hurdle having same values of the reachability set and the intersection set was given level 1<sup>st</sup> and was assigned as the utmost position in the ISM hierarchy of hurdles in implementing SSCM practices (Luthra et al., 2014e). After the first iteration, the hurdle forming level 1<sup>st</sup> was discarded and with the remaining hurdles, the above mentioned procedure was continued until the hierarchical levels of each hurdle were found. Final hierarchical levels for hurdles in implementing SSCM practices have been given in Table 3.

Table 3. Final hierarchical levels for hurdles in implementing SSCM practices.

Hurdle S.N.	Reachability Set	Antecedent Set	Intersection Set	Levels
1	1, 3, 4, 5, 6, 7, 8, 9, 10	1, 2	1	V
2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	2	2	VI
3	3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	3	I
4	3, 4	1, 2, 4, 5, 7, 8, 10	4	II
5	3, 4, 5, 6, 7, 8, 9, 10	1, 2, 5	5	IV
6	3, 6	1, 2, 5, 6, 7, 8, 10	6	II
7	3, 4, 6, 7, 8, 9, 10	1, 2, 5, 7, 8, 10	7, 8, 10	III
8	3, 4, 6, 7, 8, 9, 10	1, 2, 5, 7, 8, 10	7, 8, 10	III
9	3, 9	1, 2, 5, 7, 8, 9, 10	9	II

10	3, 4, 6, 7, 8, 9, 10	1, 2, 5, 7, 8, 10	7, 8, 10	III
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From the final reachability matrix (table 2), a structural model has been generated after removing the transitivity's links. "Unawareness among society about social practices" has been found dependent top level and "Political instability" has been found independent bottom level hurdle in implementing SSIM. ISM based hierarchical model for hurdles in implementing SSIM in Indian automobile industry has been shown in Fig. 1.

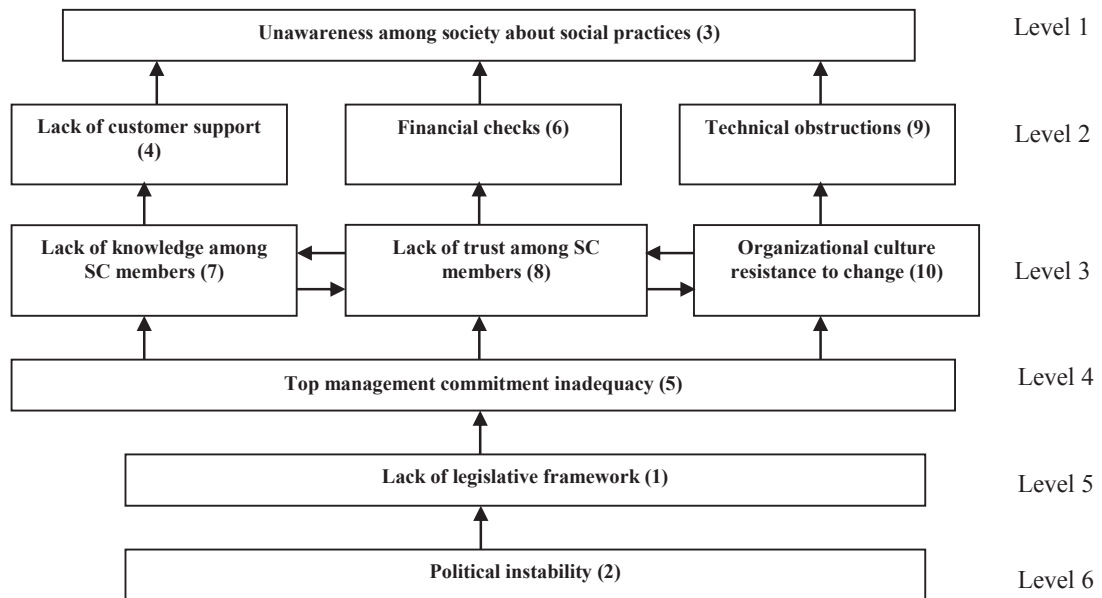


Fig. 1. ISM based hierarchical model for hurdles in implementing SSCM practices in Indian automobile sector.

These hurdles are classified into four regions named autonomous region, dependent region, linkage region and independent or driver region (Luthra et al., 2011; Kumar et al., 2013). The graph between dependence power and driving power for hurdles in implementing SSIM in automobile sector is shown in Fig. 2.

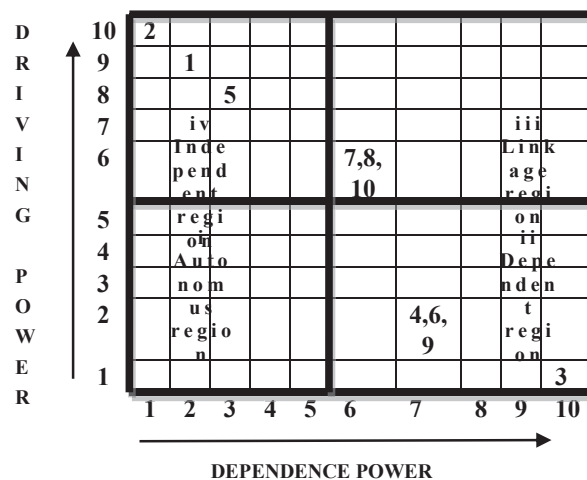


Fig. 2. MICMAC analysis of hurdles in implementing SSCM practices in Indian automobile sector.

Autonomous region hurdles can be disconnected from the system. In our study, there is no hurdle is lying in autonomous region. The second region named dependent region. Unawareness among society about social practices (3); Lack of customer support (4); Financial checks (6) and Technical obstructions (9) have been identified as dependent hurdles in implementing SSIM. The third region named linkage region. In our study, Lack of knowledge among SC members (7); Lack of trust among SC members (8) and Organizational culture resistance to change (10) have been identified as linkage region hurdles; and comes at the middle level in the ISM hierarchy. The fourth region named independent or driver region. In our study, Top management commitment inadequacy (5); Lack of legislative framework (1) and Political instability (2) have been identified as independent or driver region hurdles; and comes at the bottom level in the ISM hierarchy.

## 5. Concluding remarks

In present paper, hurdles in implementing SSCM in Indian automobile sector have been recognized and analyzed. Ten hurdles in implementing SSCM have been identified from the exhaustive literature review. Further, these identified hurdles have been validated through a decision team of experts (Academia and Indian automobile sector) by taking Indian automobile sector viewpoint. ISM methodology has been used for finding contextual relationships among hurdles and developing a hierarchy of hurdles in implementing SSCM in Indian automobile sector. “Unawareness among society about social practices” has been found dependent top level hurdle and “Political instability” has been found independent bottom level hurdle to implement SSCM in Indian automobile sector. “Political instability” has the highest driving power and the least dependence power. It will come at the bottom most level in the ISM hierarchy.

Further, MICMAC analysis has been carried out to validate the developed ISM based model and analysis of hurdles based upon dependence and driving power. Driver hurdles have high driving power and low dependence power. They will play an important role to implement SSCM in Indian automobile sector. Management needs to tackle these hurdles more cautiously. Linkage hurdles have high driving power and high dependence power. These hurdles are unstable that any action on these hurdles will have an effect on others and also a feedback on themselves. Dependent hurdles means weak drivers but strongly dependent on other hurdles. These hurdles may be removed by removing driver and linkage hurdles.

This model suggests how these hurdles in implementing SSCM in Indian automobile sector are interdependent. The developed hierarchical structural model will enable as an effective decision making tool to SC practitioners/managers for addressing these hurdles more efficiently towards effective implementation of SSCM practices in Indian automobile sector.

Every research has its own limitations. Our present research has also its own limitations which provide further research directions. In our study we have tried to establish the linkage between hurdles in implementing SSCM in Indian automobile sector using ISM methodology. Though the model is developed on basis of opinion of experts from selected academia and automobile sector, as it is natural, opinions of experts may be different or biased. However the ISM model have been derived and further validated it using MICMAC analysis may not be accepted by the empirical researchers community as in ISM methodology uses few responses which are far below than minimum number of samples size needed for statistical validation.

In future work, the derived ISM based hierarchical model may be tested using Structural equation modeling (SEM). Graph theoretic approach may be used to quantification of identified hurdles. Fuzzy ISM may be used as a future work, which can be an improvement over binary ISM.

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